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BOREAS RSS-14 Level-1 GOES-8 Visible, IR and Water Vapor Images

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BOREAS RSS-14 Level-1 GOES-8 Visible, Infrared, and Water-Vapor Images

David Faysash, Harry J. Cooper, Eric A. Smith, Jeffrey A. Newcomer

Summary

The BOREAS RSS-14 team collected and processed several GOES-7 and GOES-8 image data sets that covered the BOREAS study region. The level-1 BOREAS GOES-8 images are raw data values collected by RSS-14 personnel at FSU and delivered to BORIS. The data cover 14-Jul-1995 to 21-Sep-1995 and 01-Jan-1996 to 03-Oct-1996. The data start out containing three 8-bit spectral bands and end up containing five 10-bit spectral bands. No major problems with the data have been identified. The data are contained in binary image format files.

Note: due to the large size of the images, the level-1 GOES-8 data are not contained on the BOREAS CD-ROM set. An inventory listing file is supplied on the CD-ROM to inform users of what data were collected. The level-1 GOES-8 image data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC). See sections 15 and 16 for more information.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS RSS-14 Level-1 GOES-8 Visible, Infrared, and Water-Vapor Images

1.2 Data Set Introduction

For the BOReal Ecosystem-Atmosphere Study (BOREAS), the level-1 Geostationary Operational Environmental Satellite 8 (GOES-8) imagery, along with the other remotely sensed images, was collected in order to provide spatially extensive information over the primary study areas at varying spatial scales. The GOES-8 data set has a significant improvement in spatial resolution over the GOES-7 data from 1994 and early 1995.

1.3 Objective/Purpose

The primary objective for the GOES-8 images in 1995 and 1996 was to collect visible, infrared (IR), and water-vapor channel data covering the BOREAS region at a sufficiently high temporal frequency for subsequent use in analyzing weather events and deriving temporal surface radiation parameters and patterns that existed during the Focused and Intensive Field Campaigns (FFC and IFC).

1.4 Summary of Parameters

The level-1 GOES-8 image data for 1995 and 1996 are digital counts for all bands and are centered at 55.0 degrees north latitude and 102.0 degrees west longitude. In addition to the image data, each data file contains a header record that contains descriptive information (see Section 8.2). The GOES-8 data set starts out as a three-band 8-bit data set in 1995 and changes to a five-band 10-bit data set in 1996. The image sizes varied in 1995 as well but stabilized in 1996.

1.5 Discussion

None given.

1.6 Related Data Sets

BOREAS RSS-14 Level-1 GOES-7 Images from 1994 and 1995
BOREAS RSS-14 Level-1a GOES-7 Images from 1994 and 1995
BOREAS RSS-14 Level-2 GOES-7 1994 Surface Radiation Data
BOREAS RSS-14 Level-1a GOES-8 Images from 1995 and 1996

2. Investigator(s)

2.1 Investigator(s) Name and Title

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2.2 Title of Investigation

GOES Imagery for the BOREAS Experimental Areas

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3. Theory of Measurements

The mission of the GOES satellite series is to provide the nearly continuous, repetitive observations that are needed to predict, detect, and track severe weather. GOES spacecraft are equipped to observe and measure cloud cover, surface conditions, snow and ice cover, surface temperatures, and the vertical distributions of atmospheric temperature and humidity. They are also instrumented to measure solar X-rays and other energetics, collect and relay environmental data from platforms, and broadcast instrument data and environmental information products to ground stations. The GOES system includes the satellite (with the GOES instrumentation and direct downlink data transmission capability); the National Environmental Satellite, Data and Information Service (NESDIS) facility at Wallops Island, VA; and the ground systems at NESDIS.

4. Equipment

4.1 Sensor/Instrument Description (GOES-8)

The GOES I-M Imager on the GOES-8 satellite is a five-channel (one visible, four IR) imaging radiometer for measuring radiant and reflected energy from Earth. Using a servo-driven, two-axis gimbaled mirror scan system with a Cassegrain telescope, the multispectral channels simultaneously sweep an 8-km (5-statute-mile) north-to-south swath along an east-to-west/west-to-east path, at a rate of 20 degrees east-west per second.

The Imager consists of electronics, power supply, and sensor modules. The sensor module containing the telescope, scan assembly, and detectors is mounted on a base plate external to the spacecraft, together with the shields and louvers for thermal control. The electronics module provides redundant circuitry and performs command, control, and signal processing functions; it also serves as a structure for mounting and interconnecting the electronic boards for proper heat dissipation. The power supply module contains the converters, fuses, and power control for interfacing with the spacecraft electrical power subsystem. The electronics and power supply modules are mounted on the spacecraft internal equipment panel.

Imager Instrument Characteristics	Spectral Bands (micrometers)				
	VIS	IR2	IR3	IR4	IR5
Wavelength (micrometers)	0.55 to 0.75	3.80 to 4.00	6.50 to 7.00	10.20 to 11.20	11.50 to 12.50
Clouds	X	X	X	X	X
Water Vapor			X	X	X
Surface Temp		0		X	0
Winds	X		X	X	
Albedo & IR Flux	X		0	X	0
Fires & Smoke	X	X		0	0

X: Primary Spectral Channel
0: Secondary (supplementary) Spectral Channel

Field of View Defining Element:	Detector
Optical Field of View:	Square
5-channel Imaging:	Simultaneously
Scan Capability:	Full Earth/Sector/Area
Channel/Detector	Instantaneous Field of View (IFOV)
Visible/Silicon	: 1 km
Short-wave/InSb	: 4 km
Moisture/HgCdTe	: 8 km
Long-wave 1/HgCdTe	: 4 km
Long-wave 2/HgCdTe	: 4 km
Radiometric Calibration:	Space and 290 Kelvin IR internal blackbody
Signal Quantizing (NE'delta'T)	: 10 bits all channels
S/N	: Minimum 3X better than specifications
Frequency of Calibration Space	: 2.2 sec for full disk;
	: 9.2 or 36.6 sec for sector/area
Infrared	: 30 minutes typical
System Absolute Accuracy	: IR channel less than 0.1 K
Transmit Frequency	: 1676.00 MHz

4.1.1 Collection Environment

The GOES-8 data were acquired using the Florida State University (FSU) Direct Readout Ground System located in Tallahassee FL, starting on 14-Jul-1995 and continuing through 23-Oct-1996. The GOES-8 satellite orbited Earth in a geostationary orbit at an altitude of 35,788 km (19,324 nautical miles).

4.1.2 Source/Platform

Launch and data available dates for the GOES-8 satellite are:

Satellite	Launch Date	Data Range
GOES-8	13-Apr-1994	0-1024

4.1.3 Source/Platform Mission Objectives

The mission of the GOES satellite series is to provide the nearly continuous observations that are needed to predict, detect, and track severe weather. GOES spacecraft are equipped to observe and measure cloud cover, surface conditions, snow and ice cover, surface temperatures, and the vertical distributions of atmospheric temperature and humidity. They are also instrumented to measure solar X-rays and other energetics, collect and relay environmental data from platforms, and broadcast instrument data and environmental information products to ground stations.

For BOREAS, the level-1 GOES-8 imagery, along with the other remotely sensed images, was collected in order to provide spatially extensive information over the primary study areas at varying spatial scales. The primary objective for the GOES-8 images in 1995 and 1996 was to collect visible, IR, and water-vapor channel data covering the BOREAS region at a sufficiently high temporal frequency for subsequent use in analyzing weather events and deriving temporal surface radiation parameters and patterns that existed during FFC and IFC. The GOES-8 data set has a significant improvement in spatial resolution over the GOES-7 data from 1994 and early 1995.

4.1.4 Key Variables

Reflected radiation
Emitted radiation
Water vapor

4.1.5 Principles of Operation

The GOES I-M program is a continuation of the previous National Oceanic and Atmospheric Administration (NOAA)/National Aeronautics and Space Administration (NASA) collaboration to provide continuous monitoring of Earth's environment for weather forecasting and research. The objectives of the GOES I-M program are to maintain and expand the operational, environmental, and storm warning capabilities; to monitor Earth's atmosphere and surface and space environmental conditions; and to introduce improved atmospheric and oceanic observations and data dissemination capabilities.

GOES I-M is a new series of five satellites that meet these objectives, providing significant improvements in weather imagery and atmospheric sounding information in accordance with current weather service requirements, particularly in regard to the forecasting of life- and property-threatening severe storms. A novel space- and ground-based computer and communication system provides users with calibrated and navigated (i.e., Earth-located) imagery and sounding data, in real time.

The GOES I-M spacecraft meet the mission's objectives by providing:

- Independent imaging and sounding functions with instrument resolution,navigation, channelization, and signal-to-noise characteristics representing improvements over previous GOES missions.
- Full-time weather facsimile transmission.
- Data collection system transponder functions.
- Space environment monitor system.
- Search and rescue transponder functions.

These functions have resulted directly from the overall system requirements developed by NOAA and NASA together with the National Weather Service (NWS), the system's primary user. Many of the requirements are continued missions from the previous GOES D-H series of spacecraft. However, technological advancements have provided significant improvements in the reliability and availability of these systems for the new GOES I-M series.

As in the previous GOES mission, the GOES I-M system provides the above services over a region covering the central and eastern Pacific Ocean, the 48 contiguous states, and the central and western Atlantic Ocean. This is accomplished by two satellites, GOES West located at 135 degrees west and GOES East (GOES-8 in this case) at 75 degrees west. A common ground station, the Command and Data Acquisition (CDA) station located at Wallops Island, VA, services both satellites.

The GOES I-M Imaging and Sounding instruments provide significantly improved measurement capability over the previous GOES sensors. The GOES I-M five-channel Imager processes higher spatial resolution (i.e., 4 km for its IR channels) and higher radiometric sensitivity to improve the measurement of cloud and Earth's surface features. Sounding quality is improved by having more spectral channels (18 IR and 1 visible) with greatly improved radiometric sensitivity. The three-axis stabilized platform enables higher quality imagery and sounding data to be achieved through its dwell time advantage over a spinning satellite. Flexibility of scan control by both instruments combined with the three-axis stability enables rapid small-area coverage in addition to hemispheric or full-disk coverage. The new limited-area, higher frequency observation capability permits more continuous monitoring of severe weather development.

The GOES I-M generation of spacecraft has been developed by the Space Systems/Loral, Inc. (SS/L). These satellites are three-axis body stabilized, meaning that the three axes of the satellite remain stationary relative to nadir. These satellites use internal momentum wheels to provide attitude control and require corrective action from the ground to compensate for the effects of thermal gradients and solar winds. Unlike the previous GOES D-H series, the GOES I-M spacecraft's Imaging and Sounding instruments can be operated simultaneously and independently of one another.

The spacecraft's configuration is essentially a compact six-sided main body that carries the operational instruments, a continuous drive solar array attached to the south panel through a yoke assembly, a solar sail mounted off the north panel to offset solar pressure torque, a Telemetry and Command (T&C) antenna boom-mounted on the east end for full omni-directional coverage, and the Space Environment Monitoring (SEM) magnetometer on a boom off the anti-Earth side of the satellite.

The main body of the spacecraft accommodates the 5-channel visible and IR Imager and the 19-channel visible and IR Sounder, which sample radiance from Earth by identical two-axis scan systems and nearly identical telescopes in each unit. Scan control and data collection for the instruments are independent of each other and of most other activity on the spacecraft.

4.1.6 Sensor/Instrument Measurement Geometry

The flexible nature of the Imager is used to provide a star-sensing capability. Time and location of a star are predicted very accurately and related to the spacecraft location and optical field. From a set of these data, the ground control system chooses a location and a time that is convenient within the imaging schedule. At the time for the scheduled starlook, the Imager is pointed to the predicted star location, which can be anywhere within its 21 degrees N-S by 23 degrees E-W view. (These viewing limits are for star sensing only. The maximum frame size during normal imaging operations is 19 degrees N-S by 19.2 degrees E-W.) As the star passes through one or two of the eight elements of the visible array, it is sampled for Instrument Navigation & Registration (INR) purposes. The data are in the normal format and data stream for extraction and use at the ground station. During the data collection for BOREAS, the GOES-8 satellite was stationed at approximately 0.0 degrees N, 75.0 degrees W.

The Imager is a multi-channel instrument designed to sense radiant and solar-reflected energy from sampled areas of Earth's surface and atmosphere. The Imager's multi-element spectral channels simultaneously sweep an 8-km north-south (N-S) (longitudinal) swath along an east-west (E-W) (latitudinal) path by means of a two-axis gimbaled mirror scan system. Position and size of an area scan are controlled by command. Beam splitters separate the spectral channels to the various IR detector sets, which are redundant. The 1- by 8-km visible detector array consisting of eight individual detectors is not redundant.

Radiometric quality of the Imager is maintained by frequent views of space for Dark Current (DC) signal restoration. Less frequent views of the full aperture blackbody (BB) establish a high temperature calibration point that determines the radiometric conversion factor for the IR channels. The frequency of radiometric calibration depends on the thermal and electrical stability of the system. In addition to radiometric calibration, the amplifiers and data stream are checked regularly from a 16-increment electronic calibration signal. This verifies the stability and linearity of the output data.

Control of the Imager comes from a defined set of command inputs. The instrument is capable of full Earth imagery, sector imagery that contains the edges of Earth, and various sizes of area scans totally enclosed within the Earth scene. Area scan selection permits rapid, continuous viewing of local areas for monitoring of mesoscale phenomena and accurate wind determination. Area scan size and location are definable to less than one visible pixel to provide complete flexibility.

Motion of the Imager and Sounder scan mirrors causes a small but well-defined disturbance of the spacecraft attitude. This effect is gradually reduced by spacecraft control but at a rate too slow for total compensation. Since all the physical factors of the scanners and spacecraft are known and the scan positions are continuously provided to the Imager and Sounder, the disturbances caused by each scan motion on the spacecraft and distributed to each instrument are calculated by the Attitude and Orbit Control System (AOCS). The Mirror Motion Compensation (MMC) signal is developed and used in the scan system server control loop to slightly modify the scan rate and position to offset the disturbance. This simple signal and control interface provides corrections that reduce any combination of effects. With this system in place, the Imager and Sounder are totally independent, maintaining image location accuracy regardless of the other unit's operational status. If need be, this MMC scheme can be disabled by command.

The AOCS also provides an Image Motion Compensation (IMC) signal that counteracts the spacecraft attitude, orbit effects, and predictable structural-thermal effects within the spacecraft-instrument combination. These effects are detected from ranging, star sensing, and landmark features. Corrective algorithms developed on the ground are fed through the AOCS to the instruments as a total IMC signal, which includes the MMC described above.

Signal flow through the Imager maintains the maximum capability of each part of the optics, detection, and electronic subsystems to preserve the quality and accuracy of the sensed information. The signal flow starts with the radiation collected from the scene by the instrument's optical system. This scene radiance is separated into appropriate spectral channels and imaged onto the respective detectors for each channel. Each detector converts the scene radiance into an electrical signal that is amplified, filtered, digitized, and put into a data stream for transmission to a ground station.

The sensor assembly is mounted on a base plate external to the spacecraft, together with shields and louvers for radiation and heat control. The electronics module provides a structure for mounting and interconnecting the electronic boards with proper heat dissipation.

The sensor assembly contains the telescope, scan assembly, and detectors. A passive radiant cooler with a thermostatically controlled heater maintains the IR detector temperature for efficient operation. The IR heater maintains the IR detector temperature for efficient operation. The IR detectors operate at three patch temperatures: 94 K for 7 or 8 months that include the winter season, 101 K for the 4 or 5 months that include the summer season, and 104 K for radiative cooler contingencies. The visible detectors are at temperatures of 13 degrees C to 30 degrees C. Preamplifiers in the sensor assembly convert the low-level signals to higher level, low-impedance outputs for transmission by cable to the electronics module. A passive louver assembly and electrical heaters on the base aid thermal stability of the telescope and major components.

The Imager instrument acquires radiometric data simultaneously for five distinct channels. These five radiometric channels are characterized by a central wavelength denoting primary spectral sensitivity within these channels. The five channels are split into two distinct classes, visible and IR, and comprise a total of 22 detectors as follows:

- Visible-Channel 1 of the Imager contains eight visible detectors arranged in a linear fashion (v1-v8). Each detector provides an Instantaneous Geometric

- Field of View (IGFOV) of 28 microradians on a side. At the subsatellite point, this corresponds to a square pixel of 1 km per side.
- IR-Channel 3 (6.75 µm) contains two square detectors, one primary and one redundant. Each provides an IGFOV of 224 microradians corresponding to an 8-km resolution at the subsatellite point.
- IR-Channels 2 (3.9 µm), 4 (10.7 µm), and 5 (12.0 µm) each contain four detectors: two of these are the primary detectors and the other two provide redundancy. Each of these detectors is square, providing an IGFOV of 112 microradians. At the subsatellite point, this corresponds to a square pixel having dimensions of 4 km per side.

The Imager scans the selected image area in alternate directions on alternate lines. The imaging area is defined by a coordinate system related to the instrument's orthogonal scan axis. During imaging operations a scan line is generated by rotating the scanning mirror in the E-W direction while concurrently sampling each of the active imaging detectors. At the end of the line, the Imager scan mirror performs a turnaround, which involves stepping the mirror to the next scan line and reversing the direction of the mirror. The next scan line is then acquired by rotating the scanning mirror in the opposite, west-east direction, again with concurrent detector sampling. Detector sampling occurs within the context of a repeating data block format. In general, all visible detectors are sampled four times for each data block (four times 1 km wide), while each of the active IR detectors is sampled once per data block (one times 4 km wide).

4.1.7 Manufacturer of Sensor/Instrument

Aerospace/Communications Divisions of ITT
McLean, VA

4.2 Calibration

The calibration of the IR data and the normalization of the visible data are performed by the Operations Ground Equipment (OGE) on the raw data received from the spacecraft Imaging and Sounding sensors. The calibration/normalization function can be described in terms of those functions that occur during online processing and those that are performed during non-real-time operating modes.

The real-time calibration and normalization of Imager and Sounder data can be divided into a continual application process and a periodic calibration coefficient generating process. In the real-time continual application process, factory-measured detector response characteristics together with in-flight measurements made while viewing space and BB targets are used by the Sensor Processing Subsystem (SPS) to convert raw Imager and Sounder sensor data to theoretical target radiance. All radiometric image data produced by the Imager and Sounder instruments must undergo calibration/normalization processing. This function is performed in the SPS and involves the conversion of instrument output from raw digital counts to its final physical units. For IR data calibration, this process uses the recalculated gain and bias factors to adjust for detector variations over time. This calibration process takes place in the SPS. The visible data normalization is performed so that all detectors of the same instrument produce the same readings when viewing an area of uniform brightness. The data produced by the eight Imager visible channels must be normalized to prevent striping. The normalization process is performed in the SPS with data provided by the Product Monitor (PM). These data are generated by an operator performing a histogram matching using data with the full range of intensities.

The SPS maintains a current calibration data base for each satellite to be used in the real-time calibration of raw Imager and Sounder sensor data. The data base is maintained for both primary and redundant detectors. The SPS maintains the coefficients for the calibration equations that have been supplied to the data base prior to launch. This factory detector response information consists of Imager and Sounder IR nominal coefficients. The SPS data base has the equations for converting the BB thermistor output to temperature and BB temperature to equivalent target radiance. In addition, the data base contains the current calibration coefficients for the IR channels, which are based on the space and BB measurements. These calibration coefficients, computed by the SPS, are the gain and bias factors and coefficients of the quadratic terms. They must be recalculated periodically because it is expected that these factors will vary with the age and temperature of the instruments. This information is maintained, for both the Imager and Sounder, in a data base that resides in the SPS memory.

Normalization for Imager visible data is performed in real time by the Sensor Data Interface (SDI) hardware, through use of look-up tables. For Imager and Sounder IR data, calibration is performed by the SPS software, using the calculated calibration coefficients.

Imager data are ingested into the SPS via the SDI as a serial bit stream. Following ingest processing, including bit and frame synchronization, the SDI hardware under SPS software control performs normalization of the visible data. The SDI hardware uses the radiometric look-up tables to normalize Imager visible data by compensating for variation in the satellite detector response curves over time. The appropriate tables are loaded from the SPS memory into SDI hardware tables, under the control of the Imager Interface task. These look-up tables are used by the SDI to locate the correct value for a detector pixel. There are different tables for each of the eight Imager visible detectors. These radiometric tables are loaded with values that have been adjusted to incorporate the latest normalization information. Imager IR data are deposited in SPS memory without any linear transformations. Calibration is then performed by SPS software using the actual calibration equations for the IR detectors. Sounder data are deposited in the SPS memory by the SDI, following ingest processing. The Sounder Data Formatter task calibrates Sounder IR data and normalizes visible data in SPS software, using the actual calibration equations for the IR and look-up tables for the visible.

The periodic calibration coefficient generating process is performed to ensure that the best possible coefficient values are used when calibrating Imager and Sounder IR data. This process allows for periodic recalculation of the coefficients contained in the calibration data base of the SPS. Spacecraft instrument data are provided to the SPS in support of this operation. This section defines the data received from the Imager and Sounder and their use in the detector calibration process.

The Imager and Sounder in the spacecraft perform periodic in-flight sequences that support IR calibration processing the OGE. The instrument information generated includes space look, BB calibration, and Electronic Calibration (ECAL).

A space look sequence provides radiometric data for all detectors from a view of space located beyond the edge of Earth. The Imager can perform space looks in two ways. The instrument scan can be interrupted and the mirror pointed to space to take a reading; this is called a space clamp. The frame can also be made such that either the left side or the right side extends beyond Earth's edge, beyond Earthshine, into space, making the instrument scan space; this is called a scan clamp.

In space clamp mode, the Imager performs a space clamp at the start of a frame with subsequent space clamps performed upon the execution of a timer. The timer is selected at 9.2 seconds or 36.6 seconds; the timer restarts upon expiration so that space looks are at fixed intervals. Upon timer expirations, the Imager completes the line it is scanning, slews horizontally to the preselected side to a point 10.2° from nadir to perform the space look, performs a turnaround sequence, and resumes scanning the frame. The turnaround sequence includes retracing the last line three times, so the direction of the interruption is proportional to the width of the frame. The total amount of time the scan is interrupted is proportional to the number of space looks performed, and therefore, to the total size of the frame.

In scan clamp mode, the frame scan is never interrupted, but the frame actually scanned extends out into space, beyond the area of meteorological interest. The frame edge extends beyond Earth's edge, beyond Earthshine, a 0.5° wide ring around Earth, and out into space far enough to acquire a preset number of samples. Initially, the number of samples obtained by the GOES-8 Imager will be 400 IR samples, 64 microns on center, for a displacement of 1.47° beyond Earthshine. Scan clamp mode will typically be used for full disk frames, making the frame boundary lie 1.97° beyond Earth's edge at the Equator, 10.67° from nadir. In a full disk frame scanned thus, with the over scan into space applied only to one side of Earth, i.e., every other scan line, space calibration data are obtained every 2.2 seconds.

The Sounder operates in a space clamp mode similar to that of the Imager. The Sounder space clamp mode is its only mode of operation. A space look is performed by the Sounder every 2 minutes. In normal and priority modes, after each location is sounded, a timer is examined to see if a space look is necessary. The Sounder then saves the current address and slews to the space location. Upon completion, the Sounder checks to determine if ECAL and BB calibration should be performed. If not, the instrument returns to the original location.

A BB calibration consists of data samples from a view of the instrument's internal BB. Both space look and ECAL data are transmitted as part of the BB calibration operation. The ECAL data generated are used by the PM to monitor linearity of the Imager and Sounder instrument's electronic gain. In the Imager, the BB calibration is normally performed every 20 minutes, unless doing so would mean interrupting an image in process. At the most, the Imager may go 30 minutes between BB views. The BB calibration process does not interrupt any other operation and cannot occur during a frame. The only exception to this is if a frame is interrupted by a priority scan frame or a star sense operation. The BB calibration may then be performed after the "priority" operation is completed and before returning to the interrupted frame. When executing a BB calibration, the Imager outputs ECAL data, performs a space look operation, and then slews to the BB location to gather data. It then returns to space and executes another space look. In the Sounder, a BB calibration sequence is performed after every 20 minutes, unless inhibited by ground command. The Sounder BB calibration operation consists of outputting samples of ECAL, after the space look samples, and slewing to a BB. The scan mirror settles, then collects samples of BB target data prior to returning to the interrupted operation. During normal sounding, a space look or a BB calibration operation is performed when its respective timer has expired and only after the current location has been sounded before the scan system steps to the next location.

For both the Imager and Sounder, the in-flight calibration data generated, together with the raw spacecraft sensor data, are transmitted to the SPS at the CDA for use in IR calibration processing. The calibration data, ECAL, space look, and BB measurements are extracted for the Imager and Sounder data and used for calculation of the IR calibration equations. After the data have been extracted, the SPS software verifies the data and performs out-of-limit checks prior to calculating calibration coefficients. This process is performed in the instrument calibration preprocessing tasks. Here the spacecraft calibration data, from both the Imager and Sounder undergo statistical quality checks, limit checks, and verification. The good data are then averaged into a single value for each detector or detector/filter combination. The resulting space look and BB calibration data are received from the SPS memory and used by calibration processing task to compute the needed coefficients.

The SPS provides normal mode (Mode 1) calibration for both the Imager and Sounder, along with a number of "extended" modes. In the normal mode, the space look, BB, and BB temperature data resulting from the in-flight calibration sequences are used by the SPS to compute the gain and bias factors necessary for both Imager and Sounder IR calibration. The coefficients of the quadratic calibration terms are extracted from a table of factory-measured coefficients versus instrument temperature. These extended modes compensate for the effects of 1/f noise in the instruments as well as rapid changes in instrument and detector temperatures.

Upon completion of the real-time data processing, the SPS formats the calibrated infrared and normalized visible Imager and Sounder data into GOES VARiable (GVAR) processed data streams. The newly computed IR calibration coefficients and the space look and BB statistics generated during their calculation are also included in GVAR for transmission to the OGE Performance Management System (PMS) and the user community. The GVAR processed data consist of data blocks numbered 0-11. The calibrated and normalized Imager data are buffered by the SPS until space look occurs. When a space look occurs, the SPS continues to buffer the Imager data until the end of the current scan line is reached. The SPS then formats these data to be included in the GVAR blocks 0-10. Following the transmissions of blocks 0-10 is the transmission of various block 11s.

During Sounder operation, Block 11s containing the Sounder sensor data that have been calibrated and normalized by the SPS as well as the raw Sounder data are queued in the SPS for output. Blocks containing the Imager and Sounder calibration statistics generated along with the IR coefficients and the visible Normalization Look-up Tables (NLUTs) used in processing the instrument data are also queued for output, ordered according to their priority.

The non-real-time calibration/normalization functions include the generation of visible normalization coefficients and the production of short- and long-term history files of data and archive. The visible NLUTs are used in the SPS for the normalization of Imager and Sounder visible data. These NLUTs are generated periodically through an analyst-interactive histogram matching technique performed with the PM. The PM provides the capability to analyze Imager and Sounder visible data statistically through normalization diagnostics. These are performed to monitor the quality of the normalization of Imager and Sounder visible data and to provide a means to determine whether new tables are needed. To perform the diagnostic, a full-resolution normalized image sector, transferred in GVAR, is received by the PM equipment. The operator selects a sector containing cloud cover, ocean, and land masses to maximize the dynamic range represented by the values. The analyst displays and examines the image to see if it has desirable characteristics. From the displayed image, the PM automatically generates histograms and cumulative (integrated) histograms of count levels for each channel and displays them along with associated statistics. The analyst then selects a reference channel, based on long-term stability, and uses it as a basis with which to compare the remaining channels. The data generated as a result of the normalization diagnostic are available for storage, display, and printing. The statistics are stored in a normalization history file maintained in the PM. Selected plots may be displayed simultaneously with the reference detector's cumulative histogram for comparison. In addition, the delta values that result from the comparison of cumulative histograms can be displayed along with the maximum deviation from the reference detector. The analyst uses these statistics to determine the quality of the normalization performed on the visible image data and to determine whether a normalization update is warranted.

To generate new NLUTs, a raw visible data transmission from the SPS is scheduled. This is done by disabling the normalization process in the SPS. The data are received by the PM, where a high-resolution visible image sector is recorded and displayed to verify desirable characteristics. From the displayed raw image data, cumulative histograms are automatically generated and displayed. A reference detector is selected for NLUT generation. New NLUTs are then calculated for the other detectors by matching the target and the reference detector's cumulative histograms. For each target detector count value, the percentile becomes the new NLUT value for the detector. These new look-up tables are then applied to the raw image sector data, and the sector is displayed for review. Cumulative histogram statistics are generated directly from all the visible detector data stored in a high-resolution image sector. These statistics can then be plotted for further review. Once approved by the analyst, the newly generated NLUTs are sent to Orbit and Altitude Tracking System (OATS) and transmitted to the SPS, through GOES I-M Telemetry and Command System (GIMTACS), for use.

4.2.1 Specifications

The level-1 GOES-8 images have not had any calibration applied. Information on calibration procedures can be found at http://www.nnic.noaa.gov/SOCC/SOCC_Home.html. [Internet Link]

4.2.1.1 Tolerance

None given.

4.2.2 Frequency of Calibration

None given.

4.2.3 Other Calibration Information

None given.

5. Data Acquisition Methods

The GOES-8 image data were acquired using the FSU Direct Readout Ground System located in Tallahassee, FL, starting on 14-Jul-1995 and continued through 23-Oct-1996.

6. Observations

6.1 Data Notes
Not available at this revision.

6.2 Field Notes
Not applicable.

7. Data Description

7.1 Spatial Characteristics
The scanning system consists of a mirror that is stepped mechanically to provide north to south viewing, while the rotation of the GOES satellite provides west to east scanning. The mirror is stepped following each west to east scan. A sequence of 1,821 scans over 18.21 minutes is performed to provide a "full disk" view from just beyond the northern Earth horizon to just beyond the southern Earth horizon.

The BOREAS level-1 GOES-8 images were subset from the full GOES-8 data frames to cover the entire 1,000-km by 1,000-km BOREAS region. This contains the Northern Study Area (NSA), the Southern Study Area (SSA), the transect region between the SSA and NSA, and some surrounding area.

7.1.1 Spatial Coverage
The North American Datum of 1983 (NAD83) corner coordinates of the BOREAS region are:

	Latitude	Longitude
Northwest	58.979°N	111.000°W
Northeast	58.844°N	93.502°W
Southwest	51.000°N	111.000°W
Southeast	50.089°N	96.969°W

7.1.1.1 Spatial Coverage for GOES-8 Three-Band Data (14-Jul-2995 to 29-Jul-1995)
The corner latitude and longitude coordinates for the GOES-8 three-band data from 14-Jul-1995 to 29-Jul-1995 are shown in the following tables, where the value of -999.000 indicates that the sensor was viewing past the Earth horizon into outer space.

	Visible Latitude	Visible Longitude
Northwest	-999.000	-999.000
Northeast	73.054	-125.439
Southwest	45.774	-100.785
Southeast	45.323	-91.759

	IR4 Latitude	IR4 Longitude
Northwest	-999.000	-999.000
Northeast	73.117	-125.818
Southwest	45.823	-100.814
Southeast	45.372	-91.801

	IR3 Latitude	IR3 Longitude
Northwest	-999.999	-999.000
Northeast	-999.000	-999.000
Southwest	38.350	-97.267
Southeast	38.067	-89.634

7.1.1.2 Spatial Coverage for GOES-8 Three-Band Data (01-Aug-1995 to 21-Sep-1995)

The corner latitude and longitude coordinates for the GOES-8 three-band data from 01-Aug-1995 to 21-Sep-1995 are shown in the following tables, where the value of -999.000 indicates that the sensor was viewing past the Earth horizon into outer space.

	Visible Latitude	Visible Longitude
Northwest	-999.000	-999.000
Northeast	65.462	-98.345
Southwest	47.809	-107.113
Southeast	46.773	-87.996

	IR4 Latitude	IR4 Longitude
Northwest	-999.000	-999.000
Northeast	70.047	-104.477
Southwest	46.147	-105.839
Southeast	45.222	-87.592

	IR3 Latitude	IR3 Longitude
Northwest	-999.999	-999.000
Northeast	-999.000	-999.000
Southwest	38.546	-101.379
Southeast	37.971	-85.990

7.1.1.3 Spatial Coverage for GOES-8 Five-Band Data (12-Feb-1996 to 30-Apr-1996)

The corner latitude and longitude coordinates for the GOES-8 five-band data from 12-Feb-1996 to 30-Apr-1996 are shown in the following tables, where the value of -999.000 indicates that the sensor was viewing past the Earth horizon into outer space.

	Visible Latitude	Visible Longitude
Northwest	-999.000	-999.000
Northeast	65.478	-98.187
Southwest	47.808	-107.162
Southeast	46.793	-88.137

	IR2 Latitude	IR2 Longitude
Northwest	-999.000	-999.000
Northeast	70.040	-104.087
Southwest	46.150	-105.913
Southeast	45.243	-87.745

	IR3 Latitude	IR3 Longitude
Northwest	-999.000	-999.000
Northeast	-999.000	-999.000
Southwest	38.555	-101.528
Southeast	37.991	-86.186

	IR4 Latitude	IR4 Longitude
Northwest	-999.000	-999.000
Northeast	70.040	-104.087
Southwest	46.150	-105.913
Southeast	45.243	-87.745

	IR5 Latitude	IR5 Longitude
Northwest	-999.000	-999.000
Northeast	70.040	-104.087
Southwest	46.150	-105.913
Southeast	45.243	-87.745

7.1.1.4 Spatial coverage for GOES-8 Five-Band Data (01-May-1996 to 03-Oct-`996)

The corner latitude and longitude coordinates for the GOES-8 five-band data from 01-May-1996 to 03-Oct-1996 are shown in the following tables, where the value of -999.000 indicates that the sensor was viewing past the Earth horizon into outer space.

	Visible Latitude	Visible Longitude
Northwest	-999.000	-999.000
Northeast	65.354	-96.453
Southwest	47.885	-108.274
Southeast	46.777	-87.385

	IR2 Latitude	IR2 Longitude
Northwest	-999.000	-999.000
Northeast	69.565	-99.365
Southwest	46.293	-108.022
Southeast	45.208	-86.229

	IR3 Latitude	IR3 Longitude
Northwest	-999.000	-999.000
Northeast	-999.000	-999.000
Southwest	38.644	-103.275
Southeast	37.971	-84.902

	IR4 Latitude	IR4 Longitude
Northwest	-999.000	-999.000
Northeast	69.565	-99.365
Southwest	46.293	-108.022
Southeast	45.208	-86.229

	IR5 Latitude	IR5 Longitude
Northwest	-999.000	-999.000
Northeast	69.565	-99.365
Southwest	46.293	-108.022
Southeast	45.208	-86.229

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

The spatial resolution of each pixel is dependent on the off-nadir scan angle of the sensor and increases from nadir to the scanning extremes. The satellite subpoint resolution of the various channels is:

	North/South	East/West
Visible	1 km	1 km
IR2	4 km	4 km
IR3	8 km	4 km
IR4	4 km	4 km
IR5	4 km	4 km

The spatial dimensions of each pixel can be calculated from the provided latitude and longitude coordinate information (see Section 8.2).

7.1.4 Projection

The temporal sequence of images for a given day are spatially aligned and stored in the 'GOES Perfect Projection.' Detailed information about the projection is not currently available.

7.1.5 Grid Description

Not available at this revision.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

From 14-Jul-1995 through 21-Sep-1995, partial to complete data are available for 68 of the possible 70 days.

From 12-Feb-1996 to 03-Oct-1996, partial to complete data are available for 201 of the possible 235 days. One large period of missing data is 19-Jun-1996 to 03-July-1996, which resulted from hardware problems at FSU.

7.2.2 Temporal Coverage Map

Not available at this revision.

7.2.3 Temporal Resolution

From 14-Jul-1995 to 21-Sep-1995, visible, IR4, and IR3 images were acquired at 15 and 45 minutes after the hour, 24 hours a day.

During 1996, the visible, IR2, IR3, IR4, and IR5 images were acquired at 15 and 45 minutes after the hour, 24 hours a day.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The parameter contained in the image data files is: `Digital Number (DN)`

The parameters contained in the inventory listing file on the CD-ROM are:

```
         Column Name
------------------------------
SPATIAL_COVERAGE
DATE_OBS
START_TIME
END_TIME
PLATFORM
INSTRUMENT
NUM_BANDS
BAND_QUALITY
CLOUD_COVER
NUM_VIS_IMAGES
NUM_IR2_IMAGES
NUM_IR3_IMAGES
NUM_IR4_IMAGES
NUM_IR5_IMAGES
CRTFCN_CODE
```

7.3.2 Variable Description/Definition

The quantized digital number derived by the GOES-8 scanning system for the respective channel.The parameters in the CD-ROM inventory listing are:

Column Name	Description
SPATIAL_COVERAGE	The general term used to denote the spatial area over which the data were collected.
DATE_OBS	The date on which the data were collected.
START_TIME	The starting Greenwich Mean Time (GMT) for the data collected.

END_TIME	The ending Greenwich Mean Time (GMT) for the data collected.
PLATFORM	The object (e.g., satellite, aircraft, tower, person) that supported the instrument.
INSTRUMENT	The name of the device used to make the measurements.
NUM_BANDS	The number of spectral bands in the data.
BAND_QUALITY	The data analyst's assessment of the quality of the spectral bands in the data.
CLOUD_COVER	The data analyst's assessment of the cloud cover that exists in the data.
NUM_VIS_IMAGES	The number of visible GOES-8 images that are contained in the image product.
NUM_IR2_IMAGES	The number of GOES-8 IR2 images that are contained in the data unit.
NUM_IR3_IMAGES	The number of GOES-8 IR3 (water vapor) images that are contained in the data unit.
NUM_IR4_IMAGES	The number of GOES-8 IR4 images that are contained in the data unit.
NUM_IR5_IMAGES	The number of GOES-8 IR5 images that are contained in the data unit.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).

7.3.3 Unit of Measurement

For the image data files: Digital Number (DN) - counts

The measurement units for the parameters contained in the inventory listing file on the CD-ROM are:

Column Name	Units
SPATIAL_COVERAGE	[none]
DATE_OBS	[DD-MON-YY]
START_TIME	[HHMM GMT]
END_TIME	[HHMM GMT]
PLATFORM	[none]
INSTRUMENT	[none]
NUM_BANDS	[counts]
BAND_QUALITY	[none]
CLOUD_COVER	[none]
NUM_VIS_IMAGES	[counts]
NUM_IR2_IMAGES	[counts]
NUM_IR3_IMAGES	[counts]
NUM_IR4_IMAGES	[counts]
NUM_IR5_IMAGES	[counts]
CRTFCN_CODE	[none]

7.3.4 Data Source

The level-1 GOES-8 image bands were collected by the GOES I-M Imager instrument on the GOES-8 spacecraft. The raw data were received, processed and subset, and sent to the BOREAS Information System (BORIS) by personnel within the Department of Meteorology at FSU.The sources of the parameter values contained in the inventory listing file on the CD-ROM are:

Column Name	Data Source
SPATIAL_COVERAGE	[Constant software parameter value]
DATE_OBS	[Level-1 GOES-8 header record]
START_TIME	[Constant software parameter value]
END_TIME	[Constant software parameter value]
PLATFORM	[Constant software parameter value]
INSTRUMENT	[Constant software parameter value]
NUM_BANDS	[Constant software parameter value]
BAND_QUALITY	[Constant software parameter value]
CLOUD_COVER	[Constant software parameter value]
NUM_VIS_IMAGES	[Count from processing software]
NUM_IR2_IMAGES	[Count from processing software]
NUM_IR3_IMAGES	[Count from processing software]
NUM_IR4_IMAGES	[Count from processing software]
NUM_IR5_IMAGES	[Count from processing software]
CRTFCN_CODE	[Constant data base value]

7.3.5 Data Range

In 1995, the maximum range of digital numbers in each GOES-8 image band is limited from 0 (zero) to 255 so that the values can be stored in a single 8-bit (byte) field. For the 1996 data, each digital number can range from 0 to 1023 and occupies 10-bits of the 16-bit field used to store the value.The following table gives information about the parameter values found in the inventory table on the CD-ROM.

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SPATIAL_COVERAGE	N/A	N/A	None	None	None	None
DATE_OBS	14-JUL-95	03-OCT-96	None	None	None	None
START_TIME	15	15	None	None	None	None
END_TIME	2345	2345	None	None	None	None
PLATFORM	GOES-8	GOES-8	None	None	None	None
INSTRUMENT	N/A	N/A	None	None	None	None
NUM_BANDS	3	5	None	None	None	None
BAND_QUALITY	N/A	N/A	None	None	None	None
CLOUD_COVER	N/A	N/A	None	None	None	None
NUM_VIS_IMAGES	1	48	None	None	None	None
NUM_IR2_IMAGES	2	48	None	None	None	Blank
NUM_IR3_IMAGES	1	48	None	None	None	None
NUM_IR4_IMAGES	1	48	None	None	None	None
NUM_IR5_IMAGES	1	48	None	None	None	Blank
CRTFCN_CODE	CPI	CPI	None	None	None	None

Minimum Data Value -- The minimum value found in the column.
Maximum Data Value -- The maximum value found in the column.
Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the

```
                             parameter value, but the attempt was unsuccessful.
Unrel Data Value     -- The value that indicates unreliable data.  This is used
                             to indicate an attempt was made to determine the
                             parameter value, but the value was deemed to be
                             unreliable by the analysis personnel.
Below Detect Limit -- The value that indicates parameter values below the
                             instruments detection limits.  This is used to
                             indicate that an attempt was made to determine the
                             parameter value, but the analysis personnel determined
                             that the parameter value was below the detection
                             limit of the instrumentation.
Data Not Cllctd      -- This value indicates that no attempt was made to
                             determine the parameter value.  This usually
                             indicates that BORIS combined several similar but
                             not identical data sets into the same data base table
                             but this particular science team did not
                             measure that parameter.
Blank -- Indicates that blank spaces are used to denote that type of value.
N/A   -- Indicates that the value is not applicable to the respective column.
None  -- Indicates that no values of that sort were found in the column.
--------------------------------------------------------------------------------
```

7.4 Sample Data Record

A sample data record for the level-1 GOES-8 images is not available here.The following are wrapped versions of the first few records from the level-1 GOES-8 inventory table on the CD-ROM:

```
SPATIAL_COVERAGE,DATE_OBS,START_TIME,END_TIME,PLATFORM,INSTRUMENT,NUM_BANDS,
BAND_QUALITY,CLOUD_COVER,NUM_VIS_IMAGES,NUM_IR2_IMAGES,NUM_IR3_IMAGES,
NUM_IR4_IMAGES,NUM_IR5_IMAGES,CRTFCN_CODE
'REGION',14-JUL-95,15,2345,'GOES-8','GOES I-M Imager',3,'NOT ASSESSED',
'NOT ASSESSED',1,,1,1,,'CPI'
'REGION',15-JUL-95,15,2345,'GOES-8','GOES I-M Imager',3,'NOT ASSESSED',
'NOT ASSESSED',48,,48,48,,'CPI'
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data for level-1 GOES-8 images is the set of images that comprise the acquisitions for a given day from 0015 to 2345 Greenwich Mean Time (GMT). This includes all of the images acquired during that 24-hour period along with the reference latitude and longitude coordinate files. Because of reception or transmission problems, the number of images varies between days. Since each image acquisition is contained in a separate file, the number of files for a day will vary.

8.2 Data Format(s)

The CD-ROM inventory listing file consists of numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

The level-1 GOES-8 data set consisted of three bands in 1995 and changed to five bands in 1996 with the size of the images also changing over the period. The following table describes the dates and sizes; the details of the formats are given in the text contained from here through Section 8.2.4.

Start Date	End Date	Band	Number of Bits	Number of Lines	Number of Pixels
14-Jul-1995	29-Jul-1995	visible	8	1024	1024
		IR4	8	256	256
		IR3	8	256	256
01-Aug-1995	21-Sep-1995	visible	8	824	2048
		IR4	8	256	512
		IR3	8	256	512
12-Feb-1996	30-Apr-1996	visible	16	824	2048
		IR2	16	256	512
		IR3	16	256	512
		IR4	16	256	512
		IR5	16	256	512
02-May-1996	21-Oct-1996	visible	16	824	2248
		IR2	16	256	612
		IR3	16	256	612
		IR4	16	256	612
		IR5	16	256	612

A tape of 1995 level-1 GOES-8 images contains data from multiple days organized with all the data of day 1 followed by all the data from day 2, etc. The data files for a given day are arranged with the visible images first, followed by the IR4 images, then the IR3 images. The last set of six files contains the latitude and longitude coordinates for each of the image types.

```
Day 1
Visible Channel Time 1
Visible Channel Time 2
Visible Channel Time 3
.
.
.
Visible Channel Time i

IR4 Channel Time 1
IR4 Channel Time 2
IR4 Channel Time 3
.
.
.
IR4 Channel Time j

IR3 Channel Time 1
IR3 Channel Time 2
IR3 Channel Time 3
.
.
.
IR3 Channel Time k

Day 2
Visible Channel Time 1
.
.
IR4 Channel Time 1
```

```
.
.
IR3 Channel Time 1
.
.
.
Day n

Visible Channel latitude file
Visible Channel longitude file
IR4 Channel latitude file
IR4 Channel longitude file
IR3 Channel latitude file
IR3 Channel longitude file
```

A tape of 1996 level-1 GOES-8 data contains an American Standard Code for Information Interchange (ASCII) image listing file and 10 binary latitude and longitude files, followed by the image data from multiple days organized with all the data of day 1 followed by all the data from day 2, etc. The data files for a given day are arranged with the visible images first, followed by the IR2 images, then the IR4, IR5, and IR3 images like this:

```
ASCII Image Listing File
Visible Channel latitude file
Visible Channel longitude file
IR2 Channel latitude file
IR2 Channel longitude file
IR4 Channel latitude file
IR4 Channel longitude file
IR5 Channel latitude file
IR5 Channel longitude file
IR3 Channel latitude file
IR3 Channel longitude file

Day 1
Visible Channel Time 1
Visible Channel Time 2
Visible Channel Time 3
.
.
.
Visible Channel Time i

IR2 Channel Time 1
IR2 Channel Time 2
IR2 Channel Time 3
.
.
.
IR2 Channel Time j

IR4 Channel Time 1
IR4 Channel Time 2
IR5 Channel Time 3
.
```

```
.
.
IR4 Channel Time k

IR5 Channel Time 1
IR5 Channel Time 2
IR5 Channel Time 3
.
.
.
IR5 Channel Time l

IR3 Channel Time 1
IR3 Channel Time 2
IR3 Channel Time 3
.
.
.
IR3 Channel Time m


Day 2
Visible Channel Time 1
.
.
IR2 Channel Time 1
.
.
IR4 Channel Time 1
.
.
IR5 Channel Time 1
.
.
IR3 Channel Time 1

.
.
.
Day n
```

Note that because of missing images from reception or transmission problems, image file m in any of the band sequences does not necessarily correspond to the same time as image file m in any other day. The time fields in the header records must be checked to find the image channels collected at the same time. The level-1 data were processed to level-1a products that have missing images zero-filled, resulting in images collected at the same time on different days being in the same file position.

A file of level-1 GOES-8 imagery contains a header record followed by visible, IR2, IR3, IR4, or IR5 data. For 1995, the way to distinguish between the file types is by the size of the file and the information contained in bytes 1 to 4 of the header record (see details below) that is contained in the first record of the tape file. For 1996, because of an error in the FSU software, the band number field in the header record for IR2, IR4, and IR5 images is the same. Based on this and the fact that the files are the same physical size, they cannot be readily distinguished via software. BORIS staff was able to distinguish the files by reading the contents of a file sent by FSU that listed the files by type. This file is included as the first file (ASCII) on the 1996 data tapes.

The multiple-byte numeric integer fields in the header are stored as low-order byte first. The decimal number fields are Institute of Electrical and Electronics Engineers (IEEE) 4-byte floating point values. The format and contents of the header record is:

```
Bytes       Description
-------     ------------------------------------------------
1 - 4       Band number (32-bit integer; low-order byte first).
            (0 == visible; 1 == IR2; 2 == IR3, 1 == IR4; 1 == IR5).
            (Note that because of an error in the FSU software, the band number
            field for IR2, IR4, and IR5 are the same.  Based on this and the fact
            that the files are the same physical size, they cannot be
            distinguished on tape.  BORIS staff was able to distinguish the files
            by reading the contents of a file sent by FSU that listed the files
            by type.)
5 - 8       Number of Pixels (32-bit integer; low-order byte first).
9 - 12      Number of Lines (32-bit integer; low-order byte first).
13 - 16     Decimal latitude of the center of the image in decimal degrees. The
            BOREAS latitude is 55.0 degrees (55.0 N) (Binary).
17 - 20     Decimal longitude of the center of the image in decimal degrees. The
            BOREAS longitude is -102.0 degrees (102.0 W) (Binary).
21 - 132    Contents are unknown at this time.
133 - 140   Portions of the date and time as shown below.
141 - 8150  Contents are unknown at this time.

To decode the date and time information in bytes 133 to 140:

    First check that the values in bytes 133 to 140 are interpreted as
    being positive values between 0 and 255.  If any of them are negative,
    add 256 to the value. Next separate the contents of bytes 133 to 140 into an
    array like the following:

         val(1,1) contains the 16 to 128 bits of byte 133
         val(2,1) contains the 1 to 8 bits of byte 133
         val(1,2) contains the 16 to 128 bits of byte 134
         val(2,2) contains the 1 to 8 bits of byte 134
         val(1,3) contains the 16 to 128 bits of byte 135
         val(2,3) contains the 1 to 8 bits of byte 135
         val(1,4) contains the 16 to 128 bits of byte 136
         val(2,4) contains the 1 to 8 bits of byte 136
         val(1,5) contains the 16 to 128 bits of byte 137
         val(2,5) contains the 1 to 8 bits of byte 137
         val(1,6) contains the 16 to 128 bits of byte 138
         val(2,6) contains the 1 to 8 bits of byte 138
         val(1,7) contains the 16 to 128 bits of byte 139
         val(2,7) contains the 1 to 8 bits of byte 139
         val(1,8) contains the 16 to 128 bits of byte 140
         val(2,8) contains the 1 to 8 bits of byte 140

    Then: year     = val(1,1)*1000 + val(2,1)*100 + val(1,2)*10 + val(2,2)
          doy      =                 val(1,3)*100 + val(2,3)*10 + val(1,4)
          hour     =                                val(2,4)*10 + val(1,5)
          minute   =                                val(2,5)*10 + val(1,6)
          seconds  =                                val(2,6)*10 + val(1,7)
          millisec =                 val(2,7)*100 + val(1,8)*10 + val(2,8)
```

8.2.1 GOES-8 Three-Band Data Format (14-Jul-1995 to 29-Jul- 1995)

A file of visible channel data on tape consists of 51 records of 20,480 bytes followed by 1 record of 12246 bytes. The first record contains the 8,150-byte header followed by visible image data starting in byte 8151. Records 2 through 52 contain the remainder of the visible image data. The visible image contains unsigned 8-bit counts (i.e., values of 0 to 255) stored in 8-bit (1-byte) values for the 1,024 pixels in each of 1,024 lines. The pixels of a visible image have a nominal 1 km (N-S) by 1 km (E-W) spatial resolution.

A file of IR4 channel data on tape consists of three records of 20,480 bytes followed by one record of 12,246 bytes. The first record contains the 8,150-byte header followed by IR4 image data starting in byte 8151. Records 2 through 4 contain the remainder of the IR4 image data. The IR4 image contains unsigned 8-bit counts (i.e., values of 0 to 255) stored in 8-bit (1-byte) values for the 256 pixels in each of 256 lines. The pixels of an IR4 image have a nominal 4-km (N-S) by 4-km (E-W) spatial resolution.

A file of IR3 channel data on tape consists of three records of 20,480 bytes followed by one record of 12,246 bytes. The first record contains the 8,150-byte header followed by IR3 image data starting in byte 8151. Records 2 through 4 contain the remainder of the IR3 image data. The IR3 image contains unsigned 8-bit counts (i.e., values of 0 to 255) stored in 8-bit (one-byte) values for the 256 pixels in each of 256 lines. The pixels of an IR3 image have a nominal 8-km (N-S) by 4-km (E-W) spatial resolution.

The set of six reference latitude and longitude files for all the GOES-8 images collected from 14-Jul-1995 to 29-Jul-1995 is contained in the last six files on the data tape. The six files consist of a pair of latitude and longitude files for each of the visible, IR4, and IR3 image types.

The reference latitude and longitude files for the visible images each consist of 1,024 records of 4,096 bytes. Each record of 4,096 bytes contains 1,024 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR4 images each consist of 256 records of 1,024 bytes. Each record of 1,024 bytes contains 256 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR3 images each consist of 256 records of 1,024 bytes. Each record of 1,024 bytes contains 256 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

8.2.2 GOES-8 Three-Band Data Format (01-Aug-1995 to 21-Sep-1995)

A file of visible channel data on tape consists of 82 records of 20,480 bytes followed by 1 record of 16,342 bytes. The first record contains the 8,150-byte header followed by visible image data starting in byte 8151. Records 2 through 83 contain the remainder of the visible image data. The visible image contains unsigned 8-bit counts (i.e., values of 0 to 255) stored in 8-bit (1-byte) values for the 2,048 pixels in each of 824 lines. The pixels of a visible image have a nominal 1-km (N-S) by 1 km (E-W) spatial resolution.

A file of IR4 channel data on tape consists of six records of 20,480 bytes followed by one record of 16,342 bytes. The first record contains the 8,150-byte header followed by IR4 image data starting in byte 8151. Records 2 through 7 contain the remainder of the IR4 image data. The IR4 image contains unsigned 8-bit counts (i.e., values of 0 to 255) stored in 8-bit (1-byte) values for the 512 pixels in each of 256 lines. The pixels of an IR2 image have a nominal 4-km (N-S) by 4-km (E-W) spatial resolution.

A file of IR3 channel data on tape consists of six records of 20,480 bytes followed by one record of 16,342 bytes. The first record contains the 8,150-byte header followed by IR3 image data starting in byte 8151. Records 2 through 7 contain the remainder of the IR3 image data. The IR3 image contains unsigned 8-bit counts (i.e., values of 0 to 255) stored in 8-bit (1-byte) values for the 512 pixels in each of 256 lines. The pixels of an IR3 image have a nominal 8-km (N-S) by 4-km (E-W) spatial resolution.

The set of six reference latitude and longitude files for all the GOES-8 images collected from 01-Aug-1995 to 21-Sep-1995 are contained in the last six files on the data tape. The six files consist of a pair of latitude and longitude files for each of the visible, IR4, and IR3 image types.

The reference latitude and longitude files for the visible images each consist of 824 records of 8,192 bytes. Each record of 8,192 bytes contains 2,048 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR4 images each consist of 256 records of 2,048 bytes. Each record of 2,048 bytes contains 512 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR3 images each consist of 256 records of 2,048 bytes. Each record of 2,048 bytes contains 512 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

8.2.3 GOES-8 Five-Band Data Format (12-Feb-1996 to 30-Apr-1996)

The ASCII image listing file contains 80-byte records containing the date, time, and type of image for the set of image data files that follow the latitude and longitude files. For 1996, because of an error in the FSU software, the band number field in the header record for IR2, IR4, and IR5 images is the same. Based on this and the fact that the files are the same physical size, they cannot be distinguished automatically without the use of this file. The following are some example records from one of the files:

/metsat3/boreas_archive/copy1file JD043-048/9604323A.VIS.Z
/metsat3/boreas_archive/copy1file JD043-048/9604318A.IR2.Z

The last 14 characters give the year (96), the day of year (043), the time (23A == 2315 and 23B == 2345), and the image type (VIS, IR2, IR4, IR5, or IR3).

The set of 10 reference latitude and longitude files for all the GOES-8 images collected from 01-Jan-1996 to 30-Apr-1996 is contained in files 2 to 11 on the data tape. The 10 files consist of a pair of latitude and longitude files for each of the visible, IR2, IR4, IR5, and IR3 image types.

The reference latitude and longitude files for the visible images each consist of 824 records of 8,192 bytes. Each record of 8,192 bytes contains 2,048 signed 32-bit (four-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR2 images each consist of 256 records of 2,048 bytes. Each record of 2,048 bytes contains 512 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR4 images each consist of 256 records of 2,048 bytes. Each record of 2,048 bytes contains 512 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR5 images each consist of 256 records of 2,048 bytes. Each record of 2,048 bytes contains 512 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR3 images each consist of 256 records of 2,048 bytes. Each record of 2,048 bytes contains 512 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

A file of visible channel data on tape consists of 165 records of 20,480 bytes followed by 1 record of 4,054 bytes. The first record contains the 8,150-byte header followed by visible image data starting in byte 8151. Records 2 through 166 contain the remainder of the visible image data. The visible image contains 10-bit counts (i.e., values of 0 to 1023) stored in 16-bit (2-byte) values (low-order byte first) for the 2,048 pixels in each of 824 lines. The pixels of a visible image have a nominal 1-km (N-S) by 1-km (E-W) spatial resolution.

A file of IR2 channel data on tape consists of 13 records of 20,480 bytes followed by 1 record of 4,054 bytes. The first record contains the 8,150-byte header followed by IR2 image data starting in byte 8151. Records 2 through 14 contain the remainder of the IR2 image data. The IR2 image contains 10-bit counts (i.e., values of 0 to 1023) stored in 16-bit (2-byte) values (low-order byte first) for the 512 pixels in each of 256 lines. The pixels of an IR2 image have a nominal 4-km (N-S) by 4-km (E-W) spatial resolution.

A file of IR4 channel data on tape consists of 13 records of 20,480 bytes followed by 1 record of 4,054 bytes. The first record contains the 8,150-byte header followed by IR4 image data starting in byte 8151. Records 2 through 14 contain the remainder of the IR4 image data. The IR4 image contains 10-bit counts (i.e., values of 0 to 1023) stored in 16-bit (2-byte) values (low-order byte first) for the 512 pixels in each of 256 lines. The pixels of an IR4 image have a nominal 4-km (N-S) by-4 km (E-W) spatial resolution.

A file of IR5 channel data on tape consists of 13 records of 20,480 bytes followed by 1 record of 4,054 bytes. The first record contains the 8,150-byte header followed by IR5 image data starting in byte 8151. Records 2 through 14 contain the remainder of the IR5 image data. The IR5 image contains 10-bit counts (i.e., values of 0 to 1023) stored in 16-bit (2-byte) values (low-order byte first) for the 512 pixels in each of 256 lines. The pixels of an IR5 image have a nominal 4-km (N-S) by 4-km (E-W) spatial resolution.

A file of IR3 channel data on tape consists of 13 records of 20,480 bytes followed by 1 record of 4,054 bytes. The first record contains the 8,150-byte header followed by IR3 image data starting in byte 8151. Records 2 through 14 contain the remainder of the IR3 image data. The IR3 image contains 10-bit counts (i.e., values of 0 to 1023) stored in 16-bit (2-byte) values (low-order byte first) for the 512 pixels in each of 256 lines. The pixels of an IR3 image have a nominal 8-km (N-S) by 4-km (E-W) spatial resolution.

8.2.4 GOES-8 Five-Band Data Format (02-May-1996 to 03-Oct-1996)

The ASCII image listing file contains 80-byte records containing the date, time, and type of image for the set of image data files that follow the latitude and longitude files. For 1996, because of an error in the FSU software, the band number field in the header record for IR2, IR4, and IR5 images is the same. Based on this and the fact that the files are the same physical size, they cannot be distinguished automatically without the use of this file. The following are some example records from one of the files:

```
/metsat3/boreas_archive/copy1file JD043-048/9604323A.VIS.Z
/metsat3/boreas_archive/copy1file JD043-048/9604318A.IR2.Z
```

The last 14 characters give the year (96), the day of year (043), the time (23A == 2315 and 23B == 2345), and the image type (VIS, IR2, IR4, IR5, or IR3).

The set of 10 reference latitude and longitude files for all the GOES-8 images collected from

01-May-1996 to 21-Oct-1996 is contained in files 2 to 11 on the data tape. The 10 files consist of a pair of latitude and longitude files for each of the visible, IR2, IR4, IR5, and IR3 image types.

The reference latitude and longitude files for the visible images each consist of 824 records of 8,992 bytes. Each record of 8,992 bytes contains 2,248 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR2 images each consist of 256 records of 2,448 bytes. Each record of 2,448 bytes contains 512 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR4 images each consist of 256 records of 2,448 bytes. Each record of 2,448 bytes contains 512 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR5 images each consist of 256 records of 2,448 bytes. Each record of 2,448 bytes contains 512 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

The reference latitude and longitude files for the IR3 images each consist of 256 records of 2,448 bytes. Each record of 2,448 bytes contains 512 signed 32-bit (4-byte) integer latitude or longitude values. The bytes of each 32-bit value are stored as low-order byte first. The unit of each latitude and longitude value is thousandths of a degree. To get the original decimal degree values, divide each value by 1000.

A file of visible channel data on tape consists of 181 records of 20,480 bytes followed by 1 record of 5,974 bytes. The first record contains the 8,150-byte header followed by visible image data starting in byte 8151. Records 2 through 182 contain the remainder of the visible image data. The visible image contains 10-bit counts (i.e., values of 0 to 1023) stored in 16-bit (2-byte) values (low-order byte first) for the 2,248 pixels in each of 824 lines. The pixels of a visible image have a nominal 1-km (N-S) by 1-km (E-W) spatial resolution.

A file of IR2 channel data on tape consists of 15 records of 20,480 bytes followed by 1 record of 14,294 bytes. The first record contains the 8,150-byte header followed by IR2 image data starting in byte 8151. Records 2 through 16 contain the remainder of the IR2 image data. The IR2 image contains 10-bit counts (i.e., values of 0 to 1023) stored in 16-bit (2-byte) values (low-order byte first) for the 612 pixels in each of 256 lines. The pixels of an IR2 image have a nominal 4-km (N-S) by 4-km (E-W) spatial resolution.

A file of IR4 channel data on tape consists of 15 records of 20,480 bytes followed by 1 record of 14,294 bytes. The first record contains the 8,150-byte header followed by IR4 image data starting in byte 8,151. Records 2 through 16 contain the remainder of the IR4 image data. The IR4 image contains 10-bit counts (i.e., values of 0 to 1023) stored in 16-bit (2-byte) values (low-order byte first) for the 612 pixels in each of 256 lines. The pixels of an IR4 image have a nominal 4-km (N-S) by 4-km (E-W) spatial resolution.

A file of IR5 channel data on tape consists of 15 records of 20,480 bytes followed by 1 record of 14,294 bytes. The first record contains the 8,150-byte header followed by IR5 image data starting in byte 8151. Records 2 through 16 contain the remainder of the IR5 image data. The IR5 image contains 10-bit counts (i.e., values of 0 to 1023) stored in 16-bit (2-byte) values (low-order byte first) for the 612 pixels in each of 256 lines. The pixels of an IR5 image have a nominal 4-km (N-S) by 4-km (E-W) spatial resolution.

A file of IR3 channel data on tape consists of 15 records of 20,480 bytes followed by 1 record of 14,294 bytes The first record contains the 8,150-byte header followed by IR3 image data starting in byte 8,151. Records 2 through 16 contain the remainder of the IR3 image data. The IR3 image contains 10-bit counts (i.e., values of 0 to 1023) stored in 16-bit (2-byte) values (low-order byte first) for the 612 pixels in each of 256 lines. The pixels of an IR3 image have a nominal 8-km (N-S) by 4-km (E-W) spatial resolution.

9. Data Manipulations

9.1 Formulae

None.

9.1.1 Derivation Techniques and Algorithms

None.

9.2 Data Processing Sequence

9.2.1 Processing Steps

FSU creates the daily level-1 GOES-8 image sets by:

- acquiring the data via Direct Readout Ground Station at FSU,
- using Weather Central Incorporated (WCI) software to minimize satellite wobble for image alignment,
- sectoring the data to cover only the BOREAS region,
- storing the data on optical disk and 8-mm tape, and
- writing the images for a given day to Digital Archive Tape (DAT) and 8-mm tape for delivery to BORIS.

BORIS staff processed the level-1 GOES-8 images by:

- copying the data to a second tape,
- checking the summary information sent by FSU with data processing results, and
- inventorying the level-1 images in the online data base.

9.2.2 Processing Changes

None.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

Wobble has been minimized by using WCI remapping software.

9.3.2 Calculated Variables

None.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

Not available at this revision.

10.2 Quality Assessment

10.2.1 Data Validation by Source

Whatever the processing level, the geometric quality of the image depends on the accuracy of the viewing geometry. Spectral errors could arise from image-wide signal-to-noise ratio, saturation, cross-talk, spikes, or response normalization caused by a change in gain.

10.2.2 Confidence Level/Accuracy Judgment

None given.

10.2.3 Measurement Error for Parameters

None given.

10.2.4 Additional Quality Assessments

The level-1 GOES-8 images were visually scanned for bad periods by FSU staff.

10.2.5 Data Verification by Data Center

BORIS personnel processed the level-1 GOES-8 images by: 1) copying the data to a second tape, 2) checking the summary information sent by FSU with data processing results, and 3) inventorying the level-1 images in the online data base.

11. Notes

11.1 Limitations of the Data

Not available at this revision.

11.2 Known Problems with the Data

Part of the BOREAS region was cut off in the first data from 1995. Because of this, the size of the images was subsequently adjusted.

11.3 Usage Guidance

None give.

11.4 Other Relevant Information

None.

12. Application of the Data Set

The GOES-8 images provide a high temporal resolution data set that would be useful for monitoring radiation loading and cloud development and movement over the BOREAS region.

13. Future Modifications and Plans

None.

14. Software

14.1 Software Description

FSU acquires the downlinked raw images on a DELL PC system, transfers them to a Silicon Graphics system, and writes the data to tape.

For further information regarding the WCI software used at FSU, please contact:

Weather Central Incorporated
5725 Tokay Blvd.
Madison, WI

BORIS staff developed software and command procedures for:

- Extracting header information from the level-1 GOES-8 images on tape and writing it to ASCII files on disk for quality checking.
- Inventorying the level-1 images in the online data base by using the extracted header information files.
- Creating binary files of scaled latitude and longitude coordinates from the original ASCII files.
- Writing the latitude and longitude files to tape.

The software mentioned above is written in the C language and is operational on VAX 6410, MicroVAX, and VAXstation systems at GSFC. The primary dependencies in the software are the tape input/output (I/O) library and the Oracle data base utility routines.

14.2 Software Access

All of the BORIS described software is available upon request. BORIS staff would appreciate knowing of any problems discovered with the software, but cannot guarantee that they will be fixed.

15. Data Access

The level-1 GOES-8 images are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/ [Internet Link].

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products
The level-1 GOES-8 data can be made available on 8-mm or DAT tapes.

16.2 Film Products
None.

16.3 Other Products
Although the inventory is contained on the BOREAS CD-ROM set, the actual GOES-8 images are not. See Section 15 for information about how to obtain the data.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation
Bobotek, A., A.S. Hechtman, R.J. Komajoa, and P.G. Woolner. July 1995. GOES I-M System description. MITRE Corporation.

Rossow, W.B., C.L. Brest, and M. Roiter. 1996. International Satellite Cloud Climatology Project (ISCCP) New Radiance Calibrations. WMO/TD-No. 736. World Meteorological Organization.

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17.2 Journal Articles and Study Reports
Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

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Sellers, P., F. Hall, and K.F. Huemmrich. 1996. Boreal Ecosystem-Atmosphere Study: 1994 Operations. NASA BOREAS Report (OPS DOC 94).

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. Bulletin of the American Meteorological Society. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. Journal of Geophysical Research 102(D24): 28,731-28,770.

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

```
AOCS    - Attitude and Orbit Control System
ASCII   - American Standard Code for Information Interchange
ATS     - Application Technology Satellite
BB      - Blackbody
BOREAS  - BOReal Ecosystem-Atmosphere Study
BORIS   - BOREAS Information System
BPI     - Bytes Per Inch
CCT     - Computer Compatible Tape
CDA     - Command and Data Acquisition
CD-ROM  - Compact Disk-Read-Only Memory
DAAC    - Distributed Active Archive Center
DAT     - Digital Archive Tape
DC      - Dark Current
DN      - Digital Number
ECAL    - Electronic Calibration
EOS     - Earth Observing System
EOSDIS  - EOS Data and Information System
ESD     - Environmental Satellite Data, Inc.
E-W     - East-West
FFC     - Focused Field Campaign
FSU     - Florida State University
GIMTACS - GOES I-M Telemetry and Command System
GIS     - Geographic Information System
GMT     - Greenwich Mean Time
GOES    - Geostationary Operational Environmental Satellite
GSFC    - Goddard Space Flight Center
GVAR    - GOES VARiable
I/O     - Input/Output
IEEE    - Institute of Electrical and Electronic Engineers
IFC     - Intensive Field Campaign
IFOV    - Instantaneous Field of View
IGFOV   - Instantaneous Geometric Field of View
IMC     - Image Motion Compensation
INR     - Instrument Navigation & Registration
IR      - Infrared
ISLSCP  - International Satellite Land Surface Climatology Project
MMC     - Mirror Motion Compensation
NAD83   - North American Datum of 1983
NASA    - National Aeronautics and Space Administration
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NESDIS   - National Environmental Satellite, Data and Information Service
NLUT     - Normalization Look-Up Table
NOAA     - National Oceanic and Atmospheric Administration
N-S      - North-South
NSA      - Northern Study Area
NWS      - National Weather Service
OATS     - Orbit and Altitude Tracking System
OGE      - Operations Ground Equipment
ORNL     - Oak Ridge National Laboratory
PANP     - Prince Albert National Park
PM       - Product Monitor
PMS      - Performance Management System
RSS      - Remote Sensing Science
SDI      - Sensor Data Interface
SEM      - Space Environmental Monitoring
SMS      - Synchronous Meteorological Satellites
SPS      - Sensor Processing Subsystem
SS/L     - Space Systems/Loral, Inc.
SSA      - Southern Study Area
T&C      - Telemetry and Command
URL      - Uniform Resource Locator
VAS      - VISSR Atmospheric Sounder
VISSR    - Visible and Infrared Spin Scan Radiometer
WCI      - Weather Central Incorporated
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11. SUPPLEMENTARY NOTES

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12a. DISTRIBUTION / AVAILABILITY STATEMENT

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12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The BOREAS RSS-14 team collected and processed several GOES-7 and GOES-8 image data sets that covered the BOREAS study region. The level-1 BOREAS GOES-8 images are raw data values collected by RSS-14 personnel at FSU and delivered to BORIS. The data cover 14-Jul-1995 to 21-Sep-1995 and 01-Jan-1996 to 03-Oct-1996. The data start out containing three 8-bit spectral bands and end up containing five 10-bit spectral bands. No major problems with the data have been identified. The data are contained in binary image format files.

Note: due to the large size of the images, the level-1 GOES-8 data are not contained on the BOREAS CD-ROM set. An inventory listing file is supplied on the CD-ROM to inform users of what data were collected. The level-1 GOES-8 image data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC). See sections 15 and 16 for more information.

14. SUBJECT TERMS

BOREAS, remote sensng science, GOES-7 and -8.

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